Decoding Greenhouse Gas Methodology, Reporting Strategies and Tax Implications for South African Companies

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The 2015 global rankings, placed South Africa in the top 12 largest Carbon Dioxide (CO_2) emitters, with the reported Greenhouse Gas (GHG) emissions for 2010, totalling 579 million tonnes CO2e[1]. The South African government has since made an international commitment to reduce emissions, relative to Business As Usual (BAU), by 34% (2020) and 45% by 20252. The National Climate Change Response Policy (NCCRP) aims to ensure a sustainable transition into a low-carbon economy that will foster economic, social and environmental adaptability[2]. These emissions reduction targets are set to follow a peak, plateau, decline (PPD) trajectory, which was started in 2016[1]. Policy implementation, mandates reporting of Greenhouse Gas (GHG) emissions and subsequently, large emitters will be held accountable through Carbon Tax. This review aims to provide an overview of the current literature, methodologies, reporting requirements and tax implications for South African companies moving into a low-carbon economy.

The Environmental Impact of the Greenhouse effect

In order to recognize the importance of these new regulations, it is imperative to have a clear grasp on the Greenhouse effect and more importantly the associated implications of this phenomenon. The Greenhouse effect (Fig.1)[3] is a phenomenon that naturally regulates the Earth's temperature, warranting the survival of life on our planet[4]. Climate change is a result of this phenomenon and worsened by increasing atmospheric Greenhouse Gases (GHGs). Climate change that results in a gradual increase of average atmospheric temperature, is better known as Global Warming. Commitment to reduce GHG emissions is driven by ensuring that the average temperature increase does not exceed 1.5°C[4]. Unfortunately, unless, the Nationally Determined Contributions (NDCs) are surpassed, global GHG emissions are set to cause temperatures to exceed this objective[5]. Historically, ecosystems adapted easily to these changes, however the rapid rate of climate change is a cause for environmental concern[6]. Studies have shown that changes in atmospheric GHG concentrations affect the security of land and oceanic ecology[1]. Rising sea levels[7] and ocean acidification has intensified, with 30% of escalating atmospheric CO_2 concentrations (+330 ppm) absorbed into the ocean[8]. Changes to the surface

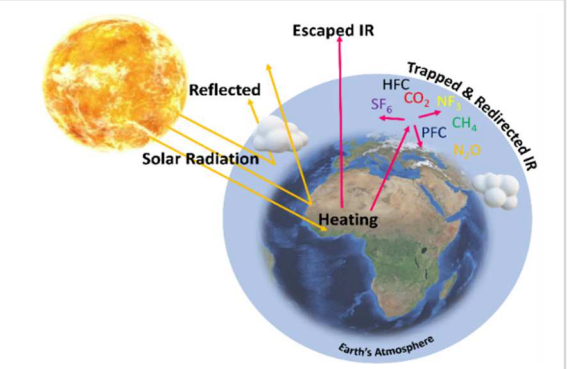

Fig1. Illustrated Greenhouse effect: Increased heating of the Earth's surface is experienced when Infrared Radiation (IR) is trapped by GHGs as the IR attempts to exit the atmosphere. Solar radiation (orange) is absorbed by the Earth's surface causing the remaining energy to be re-emitted as infrared radiation (pink). Biogenic and anthropogenic GHGs absorb this energy, creating a "blanket" effect around the Earth's surface. This naturally occurring temperature regulation system, has been altered by the increase of GHG emissions.

pH, consequently, reduces the rate of natural calcium carbonate accretion of organisms such as; coral, shellfish and molluscs[9]. These changes largely affect existing ecosystems, specifically, fish populations that rely heavily on the coral reefs for survival[10]. Furthermore, the rise in temperature results in a lack of moisture and longer drought seasons in certain areas[2], whilst precipitation in the atmosphere is intensified by 7% in other areas. Thus, heavier rainfall and storms (tropical, snowstorms or cyclones) are sustained and lead to frequent flooding[11]. The burning of fossil fuels, cultivation of livestock (enteric fermentation), use of fertilizers and deforestation are among some of the largest global GHG emitting activities[12]. South African emissions are specifically influenced by energy production (utilisation of coal), mining, transport, industrial processes and land use[2]. Gaining insight into the environmental impact of climate change and the modes by which these emissions are produced, is a prerequisite for developing mitigation strategies.

Inventory Development & Operational Boundaries

A carbon inventory is an estimation of all emissions removed and emitted over a given time frame for a specified area[13]. When completed, the inventory assists

authorities in developing cost-effective mitigation strategies, and supplies information to complete a global picture of emissions[14]. Under the Paris Agreement, the South African government is mandated to report reliable national GHG emissions and thus, adopted mechanisms by which this carbon inventory can be developed[14]. As a result, the Technical Guidelines for Monitoring, Reporting and Verification of Greenhouse Gas Emissions by Industry[15] has been developed. A well compiled inventory, according to the IPCC 2006 standards will be; consistent (timelessness), complete, improved, comparable, transparent and accurate[13]. Carbon inventories are developed by those who have operational control of the facility.

Operational control is defined as a company or subsidiary with the authority to influence and implement operational policies[16]. Operational boundaries will clearly dictate which direct emissions the company is mandated to report[15]. Company ownership does not always allocate the ownership of emissions, particularly with respect to fugitive emissions or auto-producers. Once the operational control is defined for a facility, the responsible party is required to assess whether their total installed capacity exceeds the IPCC thresholds[15].

Please refer to the link; https://www.environment.gov.za/sites/default/files/legislations/technicalguidelinesformrvofemissionsbyindustry_0.pdf for these values.

Reporting Requirements

Currently, the GHG emissions pertinent to reporting and carbon tax are[17]; Sulphur hexafluoride (SF_6), Perfluorocarbon (PFC), Hydrofluorocarbon (HFC), Carbon Dioxide (CO_2), Methane (CH_4) and Nitrous Oxide (N_2O). According to Gazette Vol.622 April 2017 No. 40762, eligible data reporters, can be subdivided into category A and B reporters[18]. Category A reporter is a person in operational control of an activity, at or exceeding, the 2006 IPCC threshold. Category B reporter by comparison is known as any organ of state, research institution or academic institution, which holds GHG emission data or activity data relevant for calculating greenhouse gas emissions relating activities listed. Reporting should exclude all non-South African emissions as well as road transport.

To ensure that the 2006 IPPC standards are adhered to, the Technical Guideline is used in conjunction with the South African Atmospheric Emissions Licensing Inventory Portal (SAAELIP), the National GHG Inventory System (NGHGIS) and the National Atmospheric Emission Inventory System (NAEIS)[19]. This system aims to provide a single login/ single platform into which emissions can be reported. Category A reporters are required to submit their emissions to NAEIS. Additionally, facilities producing emissions and exceeding thresholds under categories specified by the NAEIS, should hold a valid Atmospheric Emissions Licence (AEL) and report online. The basis of the regulations and inventory requirements were developed around the 2006 IPCC guidelines. Emissions are coded into sectors based on the activities under which they were produced. These sectors are (1) Energy, (2) Industrial Processing and Product Use (IPPU), (3) Agriculture, Forestry and other Land Use (AFOLU) and (4) Waste. Emissions resulting from the practice of activities listed under these sectors should be reported. Reporting emissions produced from AFOLU processes are currently not mandated, however stationary combustion activities (1A), which are conducted under AFOLU practices, should be reported accordingly[15]. It is important to analyse the plant operations, technology used, starting materials, possible products and emissions produced at each stage of production[18]. Emissions can then be separated into appropriate sectors.

Reporting systems have been established in South African but require refinement. Thus, GHG emissions and company registration should be completed manually by email (NAEISAdmin@environment.gov.za) (Please refer to the templates; Gazette No. 40762, Vol. 622, 3 April 2017). The primary focus of NAEIS is to report emissions from the listed activities gazetted in notice 964 of 2012. Currently, lead, Particulate Matter 10 µm (PM10), Particulate Matter 2.5 µm (PM2.5), Sulphur Dioxide (SO2), Nitrogen Oxide (NOX), Carbon Monoxide (CO) and Volatile Organic Compounds (VOCs) emissions should be reported on NAEIS. The Department of Environmental Affairs will open the portal for GHGs in the future[18]. Emissions data will be stored for a 5-year period, in which emission trends can be determined and reviewed. The System for National Atmospheric Emission Licensing (SNAEL) is a tool to develop a single platform that can manage AEL as well as reported emissions[20]. The following links provide a step-by-step guide to registering an AEL facility on SAAELIP and reporting emissions NAEIS;

a) SAAELIP registration: https://saaelip.environment.gov.za/SAAELIP/SAAELIP_FACILITY/Client/SNAEL/Doc/Video/SAAELIP%20Video%20Tutorial_SNAEL%20Final%20v2.html
b) NAEIS Submissions: https://saaelip.environment.gov.za/SAAELIP/SAAELIP_FACILITY/Client/SNAEL/Doc/VideoNAEIS/NAEIS%20TUTORIAL.html

c) QRG to SAAELIP portal functionality: https://saaelip.environment.gov.za/SAAELIP/SAAELIP_AUTHORITY/Client/SNAEL/Doc/SAAELIP_Authority_Portal_User_Guide.pdf

It is mandatory for all reporting facilities to submit emission reports by the 31st March of every year. These emissions will therefore indicate practices from the previous year. "Offenses" are deemed as, failing to comply with regulations 5(1), 5(2), 6(1), 6(3), 7(1), 7(3), 9, or 13 of the Government Gazette, 3 April 2017, or reporting misleading information. Implications of such offences, if liable, may result in a fine, not exceeding R5 million for the 1st conviction or imprisonment for a period not exceeding 5 years. In the event of a subsequent conviction, a fine not exceeding R10 million or imprisonment for a period not exceeding 10 years and in respect of both instances will be viable[18].

Methodology

Table 1: A summary of the three methodologies and general formula to follow for determining CO_2e[6].

Tier	Accuracy/ Uncertainty	Requirements	Level of Approach
1	Low / High	**Activity Data:** a) Quantity of carbonaceous fuel used. [Invoices, shipping documents] b) Production records [Crude throughput, flaring volumes & production outputs]	Conservative
2	Medium / Reduced	Same as (a) above as well as **plant/ country specific emission factors** & technology.	Intermediate
3	High /High	**Activity Data:** 1. Mass balance measurements: quantity of overall emissions from input & output of the process. 2. CEM approach: actual measured emission levels. 3. Process models & technology based on facility level parameters	Accurate
General Formula: $(E)_{ij} = AD \times EF_{ij}$		AD: Activity data (Quantity of raw materials used) EF_{ij}: Emission factors of (j) from (i) $(E)_{ij}$ Emissions or removals released of gas type (j) from fuel type (i)	

The 2006 IPCC separates the methodology into a 3-tiered system; each method is based on the data available to the data provider, determining the complexity. The formula supplied in table 1, provides an overview of the data required for each sector. The "activity data" required, is specified in Gazette No. 40762, Vol. 622, 3 April 2017. Each fuel source/ raw material used, has a designated emission factor, which is the coefficient that correlates the unit of gas removed, or emitted per unit of activity. This factor largely determines the tier used. Concession for the use of tier 1 methodology, in certain sectors, has been granted to South Africa for a transitional 5-year period. This affords large emitters the opportunity to include more renewable energy sources into their operations. Tier 3 does not require emission factors, however, detailed information on plant operations is required. CEMs or a carbon mass balance approach is required for Tier 3 data collection. Carbon mass balance provides a top down approach. This is a holistic approach, incorporating the inputs and outputs of the facility and stockpiles for estimating emissions[18]. Emissions are multiplied by the Global Warming Potential of the given gas to determine the Carbon Dioxide equivalent ($CO2_e$). The totalled GHG emissions are reported in this form to relate values in terms of CO_2. For more detailed, sector specific calculations, please consult the Technical Guidelines[15].

Tax Implications & Incentives

The Carbon Tax Bill assigns financial obligations to companies emitting pollution under the activities regulated by the IPCC sectors[17]. The current cost of goods and services does not account for the pollution produced by these companies[17]. Thus, companies neglect to take ownership of the environmental ramifications of their practices[21]. Carbon pricing aims to rectify this by driving behavioural changes in industry. Collaboration between reporting methods and the bill, ensures that South African companies are appropriately monitored and made accountable. Carbon has been priced in the following ways; 1) Carbon Taxation, 2) Emission trading schemes or ":cap and trade" mechanisms[17]. Companies will be liable for penalties when limits are exceeded as well as for the associated cost incurred, to implement mitigation strategies. The Bill is founded upon fossil fuel input and GHG emissions data.

Taxation policies will be phased in over time. The first phase includes tax incentives for efficient energy use, reduction in electricity generation tariffs and credit rebates for the renewable energy premium. Changes to public transport and energy supply, aim to mitigate GHG emissions further[17].

Companies with total installed capacities, equal to, or exceeding the IPCC thresholds (e.g. 10MW (th)), are liable for carbon tax[17]. The tax base applies to these activities, whilst waste and AFOLU sectors are tax exempt until 2022. Non-stationary / mobile emissions (e.g. liquid

fuel - transport) will be taxed in the fuel tax regime[22]. Additionally, the following highlights should be noted;

- 1st tax period commences from 1 June 2019 to 31 December 2019[23]. Therefore, the first environmental levy is due in July 2020[24]. Subsequent taxation periods will commence six months following and so forth[24].
- Carbon Tax liability for fossil fuel-based electricity producers will be reduced by environmental levy payments (3.5 c/kWh), as well as a renewable energy premium to be announced by the Minister of Finance.
- The Carbon Tax base is R120 per ton of CO2e for emissions above the tax-free thresholds.
- The initial effective carbon tax rate range is R6 - R48 per ton CO2e, depending on the allowances applied.
- Annual increases will be CPI + 2% until 31st December 2022 and CPI thereafter[23].

Phase 1 of the tax implementation provides a series of tax-free allowances;

1. A basic tax-free allowance of 60%;
2. An additional tax-free allowance of 10% for process emissions.
3. An additional tax-free allowance of 10% for fugitive emissions.
4. A variable tax-free allowance for trade-exposed sectors (maximum of 10%; proportionately determined by; **[(Import + Export)/ Total sector production].** In line with the proportion of sales of specific final goods to total sales of the company.

	Trade intensity	Trade exposure allowance (%)
Low trade intensity	< 10 %	0
Medium trade Intensity	≥ 10 % to < 30%	3-9
High trade intensity	≥ 30 %	10

5. A maximum tax-free allowance of 5% for above average performance; "additional" measures voluntarily taken to reduce GHG emissions, exceeding that of others, are granted a performance allowance. This is determined by a Z factor;
   Z (%) =(A/B-1) x 100 where;
   Z- Percentage allowance
   A- (GHG sector intensity benchmark (minister to release; no value available, zero is acceptable
   B- M&V greenhouse gas emissions intensity of the taxpayer with respect to the tax period;
6. A 5% tax-free allowance for companies with a Carbon Budget; taxpayers that participate in the carbon budget system during or before the tax period. The DEA confirms in writing that the taxpayer is participating in the system.
7. A carbon offset allowance of either 5% fugitive/process emissions or 10% combustion emissions

The total tax-free allowances during the first phase (up to 2022) can be as high as 95%. These tax-free allowances are summed per company practice and factored into calculating the tax liability of the company[17].

Further tax incentives include carbon offset and possible trading platforms as well as Energy Efficiency Savings (section 12L) Income Tax Allowance. SANEDI has introduced the Act to reward energy efficiency savings by a reduction in income tax. Energy savings reports need to be conducted by SANAS accredited M&V professional. The incentive allocates 95c for every verified kWh equivalent saved. This is calculated by taking the difference of the energy use before and after implementing energy saving practices. The tax allowance applies to data from a 12-month consecutive period[25]. The size or number of claims made does not have a limit. In order to claim[26]; Companies must register with SANEDI (part of the DOE), Appoint at SANAS accredited M&V body to perform activities and compile reports regarding claimed energy for the given year, the M&V body must submit the required reports to SANEDI to be evaluated and companies must receive a SANEDI certificate confirming and proving energy savings amount to be claimed for the specific year.

Calculating Carbon Tax Liability

The general formula for calculating company tax liability is; the tax base (reduced by the tax-free allowances) multiplied by the rate of the carbon tax. A CO_2e emission factor/ TJ is required to determine the overall CO2e produced for fugitive, process and combustion emissions. The following formulae apply;

Step 1: The following formula is used;

Equation 1: **(B) = {[(CO2 * 1) + (CH4 * 23) + (N2O * 296) + (C2F6 * 11 900) + (CF4 * 5 700) + (SF6 * 22 200)]/1000} * NCV_n**

where; **B**- tCO2e emission factor (CO2e emissions / TJ) per tonne of fuel source. Take note of the units used for the emission factor. This will depend on the type of emissions source activity.

Step 2:

Equation 2: **E = (A1 * B1) + (A2 * B2) + (A3 * B3) + ...+ (An * Bn)**

where;

E – Energy of combustion/ fugitive/ process emissions tCO2e

A_n – Mass (t) of the fossil fuel type n

B_n – Respective CO2e emissions factor/ Tonne of n

This is calculated and summed for all fuel sources and is used in the tax liability formula (eq.4).

Step 2a:

Fugitive emissions may differ slightly in approach as they are often measured in either mass per volume (m/vol) or volume per mass (vol/m). To calculate the CO2e emission factor per volume of emissions, the m/vol of each GHG is multiplied by its GWP and all subsequent values are totalled. Source categories reported as vol/m (underground coal mining) follow a different approach. The GHG emission factor is multiplied by the density factor for that gas and then by the GWP. Fugitive tCO2e/tonne:

[(CO2e emissions Factor/ton) =(vol.m-1) *density factor* GWP] * 1000.

Once the tCO2e/tonne is calculated, eq.2 is used to sum up the total fugitive emissions produced. CO2 emissions for surface mining in this regard is exempt as there is no acceptable density factor for carbon under the DEA standards36. The density factor of Methane is 0.67 x 10-6. Please refer to the specific examples for calculating these types of tCO2e emission factor on page 16 of the 2018 Explanatory Carbon Tax Memorandum.

Step 2b:

Eq.1-3 above are used in Tier 1 & Tier 2 methodologies for the determination of the CO2e Emission Factor / tonne. In Tier 3 methods, namely the carbon balance approach, the calculation is as follows;

Equation 3: **E=F + C + P**

where;

F- Fugitive emissions tCO2e (eq.1&2)

C- Combustion emissions tCO2e (eq 1&2)

P- Process emissions tCO2e (eq 1&2)

E- Total tCO2e

Step 3:

Once these parameters are determined, the tax base can be calculated. Equation 4 below outlines the information required for this calculation.

Equation 4:

T = [{[(E – S) * (1 – C)]-[D*(1-M)]} + {P*(1-J)} + {F*(1-K)}] *R

whereby, with respect to the given tax year;

T - Payable Tax (R)

F- Fugitive emissions GHG (tCO_2e)

E –Total fuel combusted related to GHG emissions (tCO_2e) or Energy combustion emissions

R - Tax rate

S - Emissions sequestered (tCO_2e) by the taxpayer as verified by DEA.

C - The sum of the allowable tax-free thresholds (%) related to combustion.

M- Sum of % tax-free allowances associated with diesel and petrol emissions

K- The sum of the allowable tax-free thresholds (%) related to fugitive emissions

P- Process emissions

D – Respective diesel & petrol emissions (tCO_2e) produced

J- Sum of % tax-free allowances associated with process emissions

All revenue collected will be deposited into the National Revenue Fund and will be administered through the Customs and Excise Act, 1964[27]. Ideally this fund will afford funding to renewable energy solution projects in the future[17].

Conclusions

Reports indicate that the 53.5 GtCO2e documented in 2011[1],is predicted to increase by 2.7% for[28] 2018/19. The rise in GHG emissions poses a threat to environmental and food security in South Africa and the government has made policy changes to drive mitigation strategies moving into 2019. Mandatory reporting has been implemented for all facilities exceeding the IPCC activity thresholds and the associated tax liability aims to put a handle on emissions. The current application of Carbon Tax in South Africa affords large emitters an opportunity to reduce their tax liability by as much as 95%. Additionally, certain activities have been granted a 5-year transitional period, in which they are able to adjust their current practice. While these schemes provide sustainable growth and flexibility, the current tax rate (R120 per ton of CO2e) is lower than global standards. Therefore, it is unlikely that the reductions in GHG emissions will be substantial enough

to effect considerable climate change in South Africa. Companies that are unable to effect change in their practices will be subject to the highest tax liability[22]. Subsequently, price hikes for consumer goods/services could be used to compensate for the additional tax[29].

Consultation of the emissions produced under operational control, ideally should be integrated into corporate sustainability reports[30]. A transparent carbon inventory is the first step towards developing reduction schemes. Effective change is achievable, when responsible companies manage their emissions and implement realistic mitigation strategies[30]. Furthermore, the tax will be reviewed after a three-year period, however irrespective of the outcome, drastic reduction in GHG emissions, remains imperative for economic and environmental sustainability in South Africa.

References

1. Wolpe, P. & Reddy, Y. The Contribution of Low-carbon Cities to South Africa's Greenhouse Gas Emissions Reduction Goals. 32 (2015).
2. Department of Environmental Affairs. National climate change response white paper. *Flexo* **26**, 57 (2001).
3. Working Group I. *IPCC, Climate Change 2007: The Physical Science Basis Fourth Assessment Report*. (2007).
4. Anderson, T. R., Hawkins, E. & Jones, P. D. CO2, the greenhouse effect and global warming: from the pioneering work of Arrhenius and Callendar to today's Earth System Models. *Endeavour* **40**, 178–187 (2016).
5. UN Environment; Anne Olhoff. *Emissions Gap Report 2018 Key Messages*. (2018).
6. Root, T. . *et al.* Mechanisms and management of functional abdominal pain. *J. R. Soc. Med.* **107**, 347–354 (2014).
7. UN Environment Programme, World Meteorological Organisation & United States Army Corps of Engineers Environmental Protection Agency National Oceanic and Atmospheric Adminsitration. Changing Climate and The Coast: Adaptive Responses and Their Economic, Environmental, and Institutional Implications. *EPA* **1**, (1990).
8. Hoegh-Guldberg, O. *et al.* Change and Ocean Acidification. *Science (80-.).* **318**, 1737–1743 (2008).
9. Gazeau, F. *et al.* Impact of elevated CO2 on shellfish calcification. *Geophys. Res. Lett.* **34**, (2007).
10. Byrne, M. Impact of ocean warming and ocean acidification on marine invertebrate life history stages. (2011). doi:10.1201/b11009-2
11. Trenberth, K. E. Changes in precipitation with climate change. *Clim. Res.* **47**, 123–138 (2011).
12. Food and Agriculture Organisation of the United Nations. *Greenhouse Gas Emissions from Agriculture, Forestry and Other Land Use*. (2014).
13. Eggleston, H. ., Miwa, K., Srivastava, N. & Tanabe, K. IPCC Guidelines for National Greenhouse Gas Inventories – A primer. *Ipcc* (2008).
14. Claassen, S. Mandatory GHG Reporting. (2019).
15. Department of Environmental Affairs. *Technical Guidelines for Monitoring, Reporting and Verification of Greenhouse Gas Emissions by Industry*. **TG-2016.1**, 1–197 (Department of Environmental Affairs, 2017).
16. Department of Basic Education. Government Gazette Staatskoerant. *Gov. Gaz.* **633**, 1–4 (2018).
17. Republic of South Africa National Treasury. Explanatory Memorandum on the Carbon Tax Bill. 1–50 (2018).
18. Molewa, B. E. E. *Government Gazette [The Department of Environmental Affairs]*. **622**, 2–24 (2017).
19. Department of Environmental Affairs Republic of South Africa. *South Africa's Greenhouse Gas Inventory Report*. (2015).
20. Gwaze, P. The SAAELIP Benefits to Authorities. in *Session 3.3 13th Annual Air Quality Governance Lekgotla Mitta* 1–43 (2018).
21. Department of Environmental Affairs. *Government Gazette: The Carbon Tax Act 15 of 2019*. **647**, (2019).
22. National Treasury. *Explanatory memorandum for the Carbon Tax Bill*. (2017).
23. Swart, I., Bolt, G. & Maneschijn, R. Deloitte Update : Carbon Tax Bill Placemat. **27**, (2019).
24. Singh, N. Navigating the carbon tax laws. *Brief* 1 (2019).
25. Promethium Carbon. *Report Carbon Trading in South Africa: Trading Offsets Against the Proposed Carbon Tax*. (2014).
26. Swiss Contact. *CASE STUDY : Obtaining a SARS Section 12L Tax Rebate for Improving Kiln Efficiency by Replacing Clamp Kilns with*

RVSBKs. **1**, 1–2 (2016).

27. National Treasury. CARBON TAX BILL (Annexure 3): FIRST DRAFT CARBON TAX BILL 2015 Response Document. 1–31 (2017).

28. Le Quéré, C. *et al.* Global Carbon Budget 2018. *Earth Syst. Sci. Data* **10**, 2141–2194 (2018).

29. Costas, T. & Ross, J. OPINION: SA customers to feel the pinch of carbon tax. *Businiess Report* 1 (2019). Available at: https://www.iol.co.za/business-report/opinion/opinion-sa-customers-to-feel-the-pinch-of-carbon-tax-24348270. (Accessed: 28th June 2019)

30. WBCSD and WRI. A Corporate Accounting and Reporting Standard. Revised edition. *Greenh. Gas Protoc.* 1–116 (2013).